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## **1.0 PURPOSE AND SCOPE**

(5.1.1)

This standard outlines the requirements for creating documentation for the calculation and evaluation of setpoints for instrumentation associated with, but not limited to, safety instrumented systems as identified through the Process Hazard Analysis. This standard does not provide the detail calculation methodology necessary for generating setpoints. However, this document indicates:

- The general content of an acceptable instrumentation setpoint evaluation document
- An indication of the uncertainties that are to be considered for each channel of a safety instrumented system (from sensor, signal conditioning, to final actuator)
- A generic outline and example for generating instrumentation setpoint documentation (Attachments A and B respectively).

This standard, which applies to the Tank Operations Contractor (TOC) evaluations for determining instrumentation setpoints for instruments used to verify parameters for Technical Safety Requirement compliance (TFC-PLN-02). As determined by management (usually due to project or programmatic risk), this standard may also be applied to non-safety related instrumentation particularly where there is a history of instrument channels not functioning as required to support operations. This standard requires that maintenance histories of instrument performance be continuously reviewed.

For utilities and support equipment, e.g., air compressors, there are no requirements to perform or document any setpoint requirements. However, for nuclear processing facilities there should be a basic rationale for the setpoint that is documented and maintained. The rigor to be applied in determining an adequate margin due to instrument inaccuracies and errors shall be based on the table given in Attachment C.

## **2.0 IMPLEMENTATION**

This standard is effective on the date shown in the header.

NOTE: Deviations to any requirements of this standard shall be requested from the standard document owner. Approved deviations shall be documented in the accompanying Standard Basic Document (e.g., RPP document). A Standard Basis Document shall be established prior to approval of any new deviations (reference RPP-RPT-29232).

## **3.0 STANDARD**

1. The setpoint standard evaluation process is used to develop instrumentation setpoints and establish proper documentation for generated setpoints. Figure 1 gives visual representation of the relationship between the generated instrumentation setpoint and other limit settings. The setpoint evaluation must address known contributing errors in the instrumentation channel from the process (including the primary element and the sensor) through all signal conditioning and finishing with the final actuator.
2. The evaluation documentation from the setpoint evaluation process shall address:
  - Discussion of plant operating and event conditions for which a set point is required

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- Methodologies for calculating errors, limits, uncertainties, setpoints, etc. (in accordance with the requirements specified in ANSI/ISA-S67.04.01-2000, “Setpoints for Nuclear Safety-Related Instrumentation” and ANSI/ISA-RP 67.04.01-2000, “Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation”)
  - Equations used for all calculations
  - References used to create documentation
  - Assumptions used in the calculation of instrument uncertainties
  - Loop/channel configuration for each setpoint to be determined
  - Sources and interpretation of possible uncertainties in a given loop
  - Instrumentation data
  - Discussion of the interface between setpoint determination and plant operating procedures, calibration procedures, and accident analysis (for safety related items)
  - Any applicable documentation requirements with respect to calibration and maintenance intervals of the equipment analyzed.
3. The evaluation process shall identify the instrumentation setpoint based on: operating experience, equipment qualification tests, vendor design specifications, engineering analysis, laboratory tests, and/or engineering design media (e.g., drawings, specifications, system design descriptions ). In certain cases direct discussion with the vendor may be required to clarify the exact interpretation of the data that they have made available and the limitations to its use in the application being analyzed.
  4. An allowance shall be created between the trip setpoint and the analytical limit with calculated uncertainties also being factored in the allowance. In addition, an allowance shall be created between the trip setpoint and the allowable value. These allowances are to ensure a trip occurs before the analytical value is reached. The instrument setpoint shall account for any process instrument uncertainties (that have not been accounted for and quantified in the analysis).
  5. Depending on the particular instrument being evaluated, while determining a setpoint, some or all of the following uncertainties shall be addressed in the analysis. The setpoint documentation shall clearly identify each consideration and provide the basis for why it has been included or dismissed as not applicable:
    - a. Instrument calibration uncertainties (caused by the calibration standard, calibration equipment or calibration method)
    - b. Instrument uncertainties during normal operation caused by:
      - Reference accuracy, including conformity (linearity), hysteresis, dead band and repeatability

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- Readability of the instrument (e.g., gauge markings, round-off error)
  - Power supply voltage changes
  - Power supply frequency changes
  - Temperature changes
  - Humidity changes
  - Pressure changes
  - Vibration (inservice)
  - Analog-to-digital (A-D) conversion
  - Digital-to-Analog (D-A) conversion.
- c. Instrument drift.
- d. Process-dependent effects. The determination of the trip setpoint allowance shall account for uncertainties associated with the process variable. Examples are (but are not limited to) the effect of fluid stratification on temperature measurement, the effect of changing fluid density on level measurements, and process oscillations or noise.
- e. Calculation effects. The determination of the trip setpoint allowance shall account for uncertainties resulting from the use of a mathematical model to calculate a variable from measured process variables. This applies to derived measurements where the variable is inferred from calculation or modeling of other measured variables.
- f. Dynamic effects. The behavior of a channel's output as a function of the input, with respect to time shall be accounted for either in the determination of the trip setpoint or included in the safety analyses.
- g. Calibration and installation bias accounting. Any bias of fixed magnitude and known direction due to equipment installation or calibration method can be eliminated from the analysis as these can be accounted for during calibration. If they are not accounted for by calibration then they will be accounted for in the setpoint calculation.
6. The minimum requirements needed for the setpoint evaluation are outlined in Attachment A. An example of a setpoint evaluation is included in Attachment B and should be used as a guide.
7. Once the setpoint evaluation has been generated, reviewed, and finalized (with appropriate comments incorporated) it shall be issued as an engineering document (RPP document) in accordance with the engineering document procedure requirements ([TFC-ENG-DESIGN-C-25](#)).
8. Reviews and approvals shall be obtained in accordance with the requirements specified in the appropriate releasing procedure, either an Engineering Data Transmittal ([TFC-ENG-DESIGN-C-25](#)) or an Engineering Change Notice ([TFC-ENG-DESIGN-C-06](#)).

#### **4.0 DEFINITIONS**

Allowable value. Limiting value a trip point may have, beyond this value appropriate action must be taken.

Analytical limit. Calculated or measured limit established to prevent the safety limit from being exceeded.

Drift. An undesired change in output value over a period of time where the change is unrelated to the input, environment, or the load.

Error. Mathematical difference between the theoretical value and the actual value.

Final setpoint device. A component or assembly of components, that provides input to the process voting logic for actuated equipment.

Instrument channel. An arrangement of components and modules required to generate a single protective action signal when required by a plant condition.

Safety limit. A limit on an important process variable that is necessary to reasonably protect the integrity of physical barriers that guard against the uncontrolled release of radioactivity.

Trip setpoint. A predetermined value for actuation of the final set point device to begin a protective action.

Uncertainty. Amount to which an instrument channel's output is in doubt (or the allowance made therefore) due to possible errors, either random or systematic, that have not been corrected. The uncertainty is generally identified within a probability and confidence level.

## **5.0 SOURCES**

### **5.1 Requirements**

1. TFC-PLN-02, "Quality Assurance Program Description."

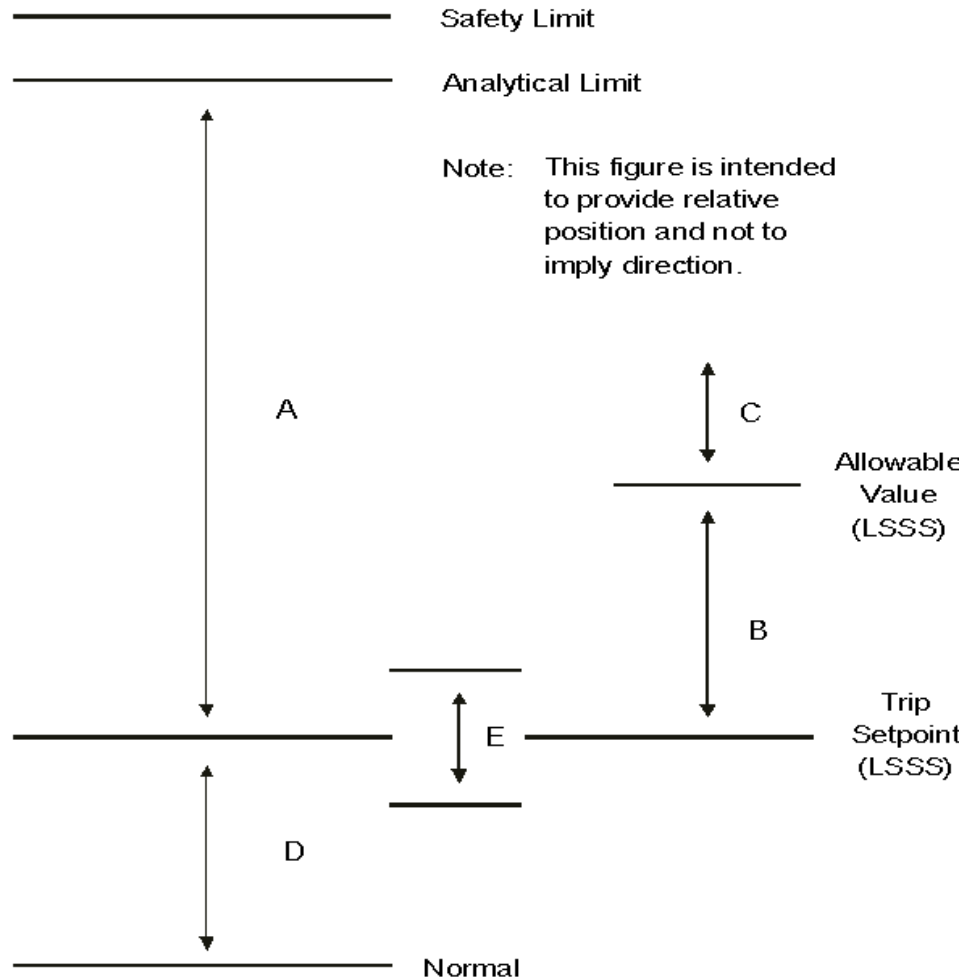
### **5.2 References**

1. ANSI/ISA-S67.04.01-2000, "Setpoints for Nuclear Safety-Related Instrumentation."
2. ANSI/ISA-S67.04.02-2000, "Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation."
3. 10 CFR 830, "Nuclear Safety Management."
4. RPP-RPT-29232, "Technical Basis Document for TFC-ENG-STD-14, Setpoint Standard."
5. TFC-ENG-DESIGN-C-06, "Engineering Change Control."
6. TFC-ENG-DESIGN-C-25, "Technical Document Control."
7. TFC-ENG-DESIGN-P-07, "System Design Descriptions."
8. TFC-OPS-MAINT-C-01, "Tank Operations Contractor Work Control."

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9. TFC-OPS-MAINT-C-06, "Notification and Evaluation of Out-of-Calibration Measuring and Test Equipment."
10. TFC-OPS-MAINT-C-07, "Control and Calibration of Measuring and Test Equipment."
11. TFC-OPS-MAINT-STD-01, "Calibration/Functional Test Status Labeling of Plant Instruments."

Figure 1. Setpoint Diagram.



- A. Allowance between trip setpoint and analytical limit
- B. Allowance between trip setpoint and allowable value
- C. Region where channel may be determined inoperable
- D. Normal facility operating condition
- E. Region of calibration tolerance

## **ATTACHMENT A – SETPOINT EVALUATION OUTLINE CONTENTS**

- 1.0 PURPOSE
- 2.0 SCOPE
- 3.0 METHODOLOGY/ACCEPTANCE CRITERIA
- 4.0 ASSUMPTIONS
- 5.0 REFERENCES
- 6.0 INSTRUMENTATION LOOP CONFIGURATION
- 7.0 INSTRUMENT CALIBRATION DATA
- 8.0 ERROR SUMMARY
  - 8.1 Loop Element Data
  - 8.2 Loop Error Elements
  - 8.3 Total Loop Error
  - 8.4 Final Loop Error
- 9.0 CONCLUSION



## **ATTACHMENT B – SETPOINT EVALUATION EXAMPLE**

### **1.0 PURPOSE**

The purpose of this document is to summarize the instrument errors associated with the Service Water Pressure Detection instruments, which are identified in the scope of this section. The results of this process will contribute to the evaluation of the selected setpoints for that equipment.

### **2.0 SCOPE**

- 2.1 The instruments included in the scope of this document are:
  - 2.1.1 SALW-PT-6014P
  - 2.1.2 SALW-PT-6014P(MTL)
  - 2.1.3 SALW-YYC-6001P

This instrument loop consists of a pressure transmitter, a Repeater/Power Supply, and a Programmable Logic Controller (PLC).

### **3.0 METHODOLOGY/ACCEPTANCE CRITERIA**

- 3.1 The general approach used in this evaluation is specified in ISA-RP67.04.02-2000, “Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation” (Ref. 5.1). The exact methodology used to determine uncertainties reflects the graded approach to safety applications in use at the Hanford site. In this report the random uncertainties are combined using the Square-Root-Sum-of-Squares (SRSS) method and the non-random uncertainties are algebraically combined to determine the resultant final uncertainty.
- 3.2 This evaluation will develop a cumulative error figure at the  $2\sigma$  confidence level.
- 3.3 Equipment stability data (drift) will be treated as a random effect for each interval specified by the manufacturer.
- 3.4 There are no defined acceptance criteria for installed equipment accuracies. The Documented Safety Analysis specifies limits on equipment performance, which will require consideration of instrument inaccuracies as provided by this document.

### **4.0 ASSUMPTIONS**

- 4.1 Repeatability, hysteresis and linearity are considered to be constituents of reference accuracy; they are incorporated where provided by the manufacturer. Otherwise, these errors are assumed to be included in the manufacturer’s reference accuracy specification.
- 4.2 Temperature, pressure, humidity and analog-to-digital or digital-to-analog conversion errors have been incorporated where provided by the manufacturer. Otherwise, these errors are assumed to be incorporated in the manufacturer’s reference accuracy specification.

#### **ATTACHMENT B – SETPOINT EVALUATION EXAMPLE (cont.)**

- 4.3 Errors associated with power supply/frequency variations and dynamic affects are assumed to be negligible with respect to other terms and thus are not treated separately in this document.
- 4.4 Measurement and test equipment (M&TE) errors and calibration accuracies are encompassed by the allowances specified in the Preventive Maintenance System (PM/S) data sheets for the instruments used to calibrate the equipment.
- 4.5 Equipment error specifications provided by manufacturers, are random errors represented by a  $2\sigma$  confidence level.
- 4.6 There are no post-accident performance requirements for this equipment.
- 4.7 This equipment is located in a harsh environment; no credit is taken for protection provided by enclosures.
- 4.8 Due to limitations on physical access, the pressure transmitter is not recalibrated at annual intervals. The nature of the Stabilization Program is such that the process is complete before 24 months have passed for any signal transmitter installation, therefore the transmitter stability will be calculated for a 24 month total exposure.
- 4.9 PLC error figures for Repeatability, Overall Accuracy Drift, Gain Error Drift, Offset Error, and Offset Error Drift are negligibly small with respect to other PLC errors and will not be treated in this document.

#### **5.0 REFERENCES**

- 5.1 ANSI/ISA-RP67.04.01-2000, “Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation.”
- 5.2 PX-880 and PX-881 Operator’s Manual, M1427/0492, OMEGA Technologies Company
- 5.3 H-14-103824, Sheets 1 thru 5, (all Rev 0), “Jumper Assembly, Saltwell Jet Pump” (Including ECN-671542)
- 5.4 H-14-103791, Sh 4, Rev. 2, Item No.73
- 5.5 H-14-103791, Sh 6, Rev. 3, Skid “P” Pumping & Instrument Control Arrangement (Including ECN-672406, Sh 8)
- 5.6 H-14-103791, Sh 7, Rev. 3, Skid “P” Pumping & Instrument Control Arrangement
- 5.7 H-14-103791, Sh 8, Rev. 2, Skid “P” Pumping & Instrument Control Arrangement
- 5.8 H-14-103791, Sh 1, Rev. 2, Skid “P” Instrument Enclosure (PLC) Arrangement
- 5.9 H-14-103792, Sh 2, Rev. 2, Skid “P” Instrument Enclosure (PLC) Arrangement

## **ATTACHMENT B – SETPOINT EVALUATION EXAMPLE (cont.)**

- 5.10 Measurement Technologies Ltd. (MTL) Intrinsic Safety Equipment Catalogue and Specifications, 2000
- 5.11 6-PCD-524, Rev. B-1, Omega Pressure Transmitter Model PX-880 Calibration
- 5.12 PM/S Data Sheet WT-06562, Jumper Flush Pressure Transducer
- 5.13 Allen-Bradley Installation Instructions, SLC 500 Analog Input/Output Modules, Publication 1746-IN008A-US-P, March 2000

### **6.0 INSTRUMENTATION LOOP CONFIGURATION**

#### **6.1 DESCRIPTION**

This loop consists of three components in series, namely the Pressure Transmitter, a Repeater Power Supply, and a PLC. Once the pressure signal is at the required value for action, the PLC completes the logic train to the operating pump and interrupts the pump power by opening the motor starter contactor.

- 6.1.1 The pressure transmitter is an Omega Model PX-880-100G1 (Ref. 5.3)
- 6.1.2 The Repeater Power Supply is an MTL Model 3041 (Ref. 5.4)
- 6.1.3 The PLC is a series of modules comprising the Allen-Bradley SLC 500 Series equipments

#### **6.2 INSTRUMENT LOCATIONS**

- 6.2.1 The pressure transmitter is located above grade, exposed to weather, or it may be located in a covered pit.
- 6.2.2 The signal conditioner/isolator is in an enclosure but is not otherwise protected from temperature extremes.
- 6.2.3 The PLC is in a climate-controlled cabinet.

### **7.0 INSTRUMENT CALIBRATION DATA**

- 7.1 The pressure transmitter is calibrated to 0-30 psig at a tolerance of  $\pm 0.5\%$  calibrated span (CS) (Ref. 5.12). The input pressure reference for this calibration is a Druck Model DP1610, 0-100 psig range. The accuracy of the Druck on this range is 0.025% full span (FS). The output signal is monitored by a Fluke Model 87 III, on the 0-40 mA scale with an accuracy of  $\pm 0.2\%$  of reading plus 2 LSD. Actual calibration error using these data is approximately 0.23% CS, however by Assumption 4.8, the total error using associated with the calibration process is bound by the error assumed in the PM/S data sheet of 0.5% CS.
- 7.2 The MTL 3041 is not calibrated.
- 7.3 The PLC is not calibrated.

## ATTACHMENT B – SETPOINT EVALUATION EXAMPLE (cont.)

### 8.0 ERROR SUMMARY

#### 8.1 Loop Element Data

Module 1:	Omega PX-880 Transmitter	
	Reference Accuracy:	±0.25%
	Range Limits:	0-20 to 0-100 psig
	Calibrated Span:	0-30 psig
	Stability:	±0.5% URL / 6 mos.
	Temperature Effect:	±1.6% URL / 50°F
	Temperature Range:	-20°F to 180°F
	Ambient Temp Range:	-20°F to 120°F(60°C)
Module 2:	MTL Model 3041 Repeater Power Supply	
	Reference Accuracy:	±0.125% CS
	Temperature Drift:	±0.00625% CS / °C
Module 3:	Allen-Bradley SLC 500 Analog Input/Output Modules, NIO4I	
	Full Scale:	20 mA
	A/D Converter Resolution:	16 bit
	Non-linearity:	0.01%
	Resolution:	1.22070µA / LSB
	Overall Accuracy (0-60°C):	±0.642% FS
	Gain Error (0-60°C):	±0.556% FS

#### 8.2 Loop Error Elements

The loop error term is a combination of reference accuracy, temperature error, calibration and M&TE errors, and stability. These errors will be combined using the SRSS method.

##### 8.2.1 Reference Accuracy

$$\text{Ref Acc}_{\text{xmtr}} = \pm(0.25\% * 30 \text{ psig}) = \pm0.075 \text{ psig}$$

$$\text{Ref Acc}_{\text{mtl}} = \pm(0.125\% * 30 \text{ psig}) = \pm0.0375 \text{ psig}$$

The PLC reference error is a combination of several terms:

$$\text{Ref Acc}_{\text{plc}} = \pm[(\text{Overall Acc})^2 + (\text{Gain error})^2 + (\text{Non-linearity})^2]^{1/2}$$

Additionally these terms include the temperature effect, thus the temperature effect for the remaining components will be calculated in a separate section.

**ATTACHMENT B – SETPOINT EVALUATION EXAMPLE (cont.)**

$$\text{Overall Accuracy} = \pm(0.642\% * 20\text{mA}) = \pm 0.1284 \text{ mA}$$

$$\text{Gain Error} = \pm(0.556\% * 20\text{mA}) = \pm 0.1112 \text{ mA}$$

$$\text{Non-linearity} = \pm(0.01\% * 20\text{mA}) = \pm 0.002 \text{ mA}$$

$$\text{Ref Acc}_{\text{plc}} = \pm[(0.1284 \text{ mA})^2 + (0.1112 \text{ mA})^2 + (0.002 \text{ mA})^2]^{1/2}$$

$$\text{Ref Acc}_{\text{plc}} =$$

$$\pm 0.1699\text{mA}$$

The loop scaling is 16mA = 100% span, thus the PLC error for reference accuracy is  
 $0.1699/16.000 = \pm 1.06\% \text{ CS}$ , or  $\pm(1.06\% * 30 \text{ psig})$

$$\text{Ref Acc}_{\text{plc}} = \pm 0.3186 \text{ psig}$$

**8.2.2 Temperature Error**

$$\begin{aligned} \text{Temp Error}_{\text{xmtr}} &= \pm [(1.6\% * 100 \text{ psig}) / 50^\circ\text{F}] * 140^\circ\text{F} \\ &= \pm 4.48 \text{ psig} \end{aligned}$$

$$\begin{aligned} \text{Temp Error}_{\text{mtl}} &= \pm [(0.00625\% * 30 \text{ psig}) / ^\circ\text{C}] * 60^\circ\text{C} \\ &= \pm 0.1125 \text{ psig} \end{aligned}$$

The transmitter and the Repeater Power Supply are both exposed to the same temperature variation due to the weather, therefore this is a common-mode term and the errors will be added arithmetically for the total temperature error figure for these two devices.

$$\text{Temp Error}_{\text{total}} = \pm 4.48 \text{ psig} + \pm 0.1125 \text{ psig}$$

$$\text{Temp Error}_{\text{total}} = \pm 4.5925 \text{ psig}$$

**8.2.3 Calibration Error**

Calibration error is  $\pm 0.5\% \text{ CS}$  by assumption 4.8. Therefore,

$$\text{Cal Error}_{\text{xmtr}} = \pm(0.5\% * 30 \text{ psig}) = \pm 0.15 \text{ psig}$$

**ATTACHMENT B – SETPOINT EVALUATION EXAMPLE (cont.)****8.2.4 Stability**

The transmitter is the only device in the loop with a stability figure, and this is based on a 6 month interval. This is a random event, therefore each 6 month interval is independent of the others and the error figures will be combined using the SRSS as follows (all data are in the URL %):

$$\text{Stability} = 0.5\% \text{ URL} / 6 \text{ months}$$

Stability error must first be extrapolated for 24 months (Assumption 4.8)

$$\text{Stability} = [(0.5)^2 + (0.5)^2 + (0.5)^2 + (0.5)^2]^{1/2} = \pm 1.0\% \text{ URL}$$

$$\text{Stability}_{\text{xmtr}} = \pm 1.0\% (100 \text{ psig}) = \pm 1.0 \text{ psig}$$

**8.3 Total Loop Error**

The total loop error is the SRSS combination of the elements calculated above. The equation describing this relationship is:

$$\text{Loop Error}_{\text{total}} = \pm [(\text{Ref Acc}_{\text{total}})^2 + (\text{Cal Error})^2 + (\text{Temp error}_{\text{total}})^2 + (\text{Stability})^2]^{1/2}$$

The total reference accuracy is the SRSS combination of the three reference accuracies, as follows:

$$\text{Ref Acc}_{\text{total}} = \pm [(\text{Ref Acc}_{\text{xmtr}})^2 + (\text{Ref Acc}_{\text{mtl}})^2 + (\text{Ref Acc}_{\text{plc}})^2]^{1/2}$$

$$\text{Ref Acc}_{\text{total}} = \pm [(0.075 \text{ psig})^2 + (0.0375 \text{ psig})^2 + (0.3185 \text{ psig})^2]^{1/2}$$

$$\text{Ref Acc}_{\text{total}} = \pm 0.3293 \text{ psig}$$

$$\text{Loop Error}_{\text{total}} = \pm [(0.3293 \text{ psig})^2 + (0.15 \text{ psig})^2 + (4.5925 \text{ psig})^2 + (1.0 \text{ psig})^2]^{1/2}$$

$$\text{Loop Error}_{\text{total}} = \pm 4.714 \text{ psig}$$

**8.4 Final Loop Error**

The instrument loop of concern is a pressure switch and the operational interest is limited to a single side of the uncertainty, that of increasing pressure. Therefore, from Section 8.1 of Ref. 5.1, the following is used to modify the total loop error figure:

A single side of interest in a setpoint reduces the  $\sigma$  value from  $2\sigma$  to  $1.645\sigma$  which results in a reduction of the total loop error figure by the following fraction:

$$\text{Final Loop Error} = [1.645\sigma / 2.00\sigma] * \pm 4.714 \text{ psig}$$

$$\text{Final Loop Error}_{(\text{single side / worst case scenario})} = +3.8773 \text{ psig}$$

**ATTACHMENT B – SETPOINT EVALUATION EXAMPLE (cont.)**

**9.0 CONCLUSION**

The Technical Safety Requirements Limiting Condition for Operation (LCO) 3.1.2, “Backflow Prevention Systems,” has the following surveillance requirement:

SR 3.1.2.2      Perform FUNCTIONAL TEST on the service water pressure detection systems and VERIFY a setpoint of  $< 20 \text{ lb/in}^2$  gauge on increasing pressure (frequency of 365 days).

The analytical limit is therefore  $< 20 \text{ lb/in}^2$  gauge. The current Work Management System/ PM/S data sheet (WT-06562) identifies the transducer is set for a range of 0 to  $30 \text{ lb/in}^2$  gauge. The midpoint of the range ( $15 \text{ lb/in}^2$  gauge) is the setpoint established in the PLC software.

The  $15 \text{ lb/in}^2$  gauge setpoint, plus the  $\sim 3.9 \text{ lb/in}^2$  gauge loop error/uncertainties (as identified in step 8.4) equals a total of  $18.9 \text{ lb/in}^2$  gauge. This is the allowable value. Since the allowable value is less than the analytical limit the setpoint of  $15 \text{ lb/in}^2$  gauge is validated.

The difference between the allowable value ( $18.9 \text{ lb/in}^2$  gauge) and the analytical limit ( $20 \text{ lb/in}^2$  gauge) is the allowance that is defined using prudent engineering judgment .

**SETPOINT =  $15 \text{ lb/in}^2$  gauge**

## ATTACHMENT C - SETPOINT SURVEY EXAMPLE

Instrument channel purpose	Documented setpoint	Response to setpoint	Maintenance History	Recommendation	Reason
Interlock before safety trip point		Automatic closure or stoppage of final element		These should be considered for process measurement uncertainty and any fixed biases should be compensated for during calibration	If these items trip due to lack of margin then they will place a demand on the safety instrumented system
Alarm before safety trip point		Notification for operator to adjust process parameters to prevent further deviation or closure or stoppage of final element		These should be considered for process measurement uncertainty and any fixed biases should be compensated for during calibration	If these items alarm due to lack of margin then they will place an undue demand on operations or ultimately place a demand on the safety instrumented system
Interlock for asset protection		Automatic closure or stoppage of final element	Poor performance	These should be considered for process measurement uncertainty and any fixed biases should be compensated for during calibration	Places an undue demand on operations
Interlock for asset protection		Automatic closure or stoppage of final element	Acceptable performance	No action required	
Alarm for asset protection		Notification for operator to adjust process parameters to prevent further deviation or closure or stoppage of final element	Poor performance	These should be considered for process measurement uncertainty and any fixed biases should be compensated for during calibration	Places an undue demand on operations
Alarm for asset protection		Notification for operator to adjust process parameters to prevent further deviation or closure or stoppage of final element	Acceptable performance	No action required	